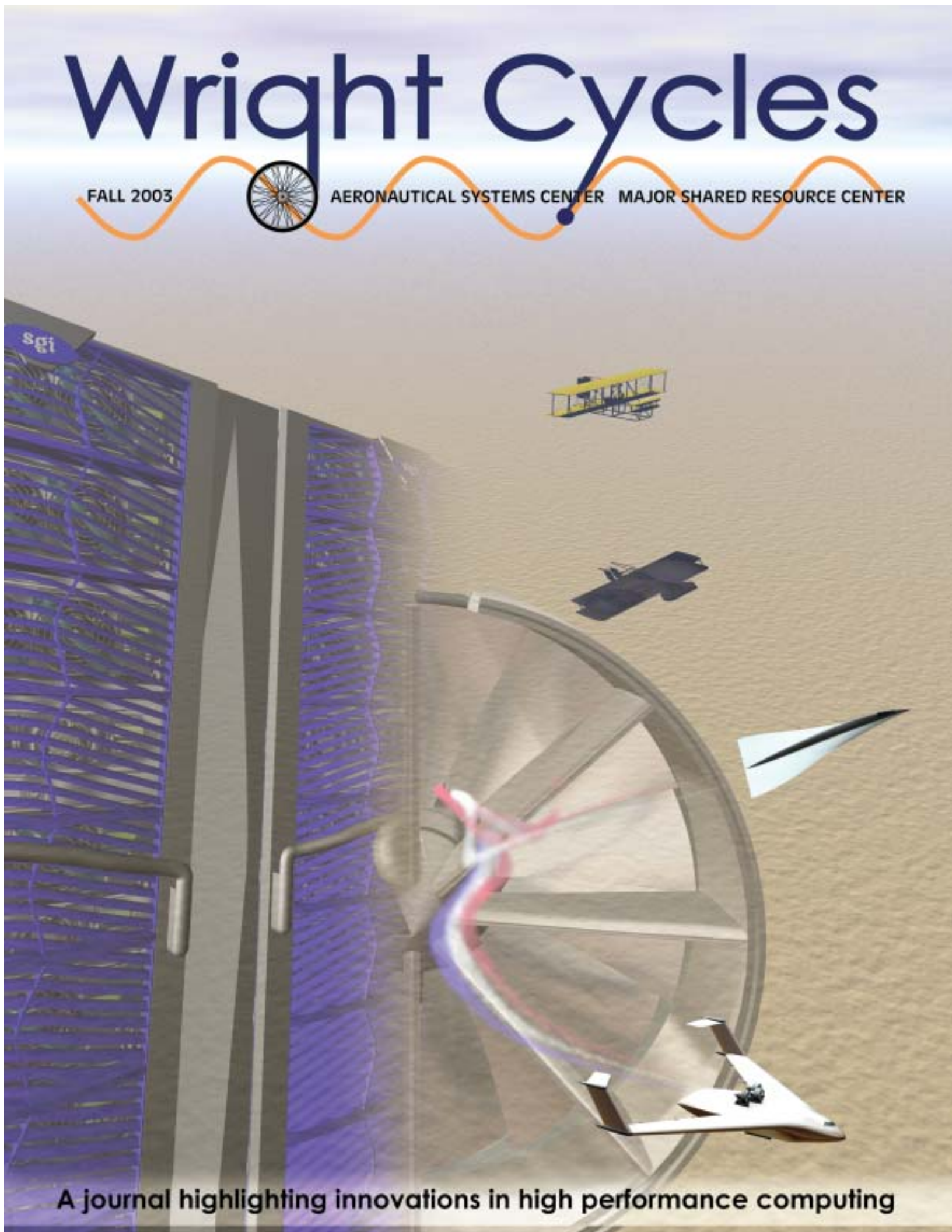
Wright Cycles

FALL 2003 AERONAUTICAL SYSTEMS CENTER MAJOR SHARED RESOURCE CENTER



A journal highlighting innovations in high performance computing

The Director's Desk

Steve Wourms
ASC MSRC Director

Ah, Fall. Skies turn gray. The air cools. Leaves turn a kaleidoscope of colors. The root cellar is stocked for the hearty Midwestern Winter to come. The World Series. The joys of college football. Oktoberfests. A time to kick back and enjoy life and maybe slow down a minute.

Not a chance. We're as busy as ever here in the High Performance Computing Division of the Advanced Computational Analysis Directorate.

Our new SGI Origin 3900 machines are all in production and being heavily utilized. Rich Gestrich's article in this edition of the *Wright Cycles* gives all the details of the new system. The ribbon-cutting event, heralding the arrival of the new systems, brought Lieutenant General Reynolds and other dignitaries to the ASC MSRC in October. Photos of the ribbon cutting follow Rich's article.

After a year of preparation, the Center recently came through the Comprehensive Security Assessment (CSA) with flying colors! The CSAs are conducted by the HPCMP on an annual basis, and I'm proud to report that our results were stupendous. The CSA team stated that this was our best CSA ever, that our staff is superbly conscientious and proactive. Three cheers for my staff!

The Programming Environment and Training (PET) group continues to be involved in a variety of activities. Dr. Steven Wong (CEN) and Dr. Rhonda Vickery (ET) have joined the ASC MSRC as on-site Leads. Brian Schafer introduces Dr. Wong and Dr. Vickery in articles that appear in this issue of the *Wright Cycles*. The 2003 Summer Intern Program was a huge success with eight absolutely fabulous young adults participating. On the downside, we recently said good-bye to Dr. Ron Hinrichsen (CSM on-site), and wish him the best in his new endeavors.

ASC MSRC is Number One! We currently have the highest Habu rating within the Program! But wait, what's a Habu, you ask? I found out that it is a variety of things: a style of sunglasses; a beer by the Cedar Brewing Co. ("Nitro Habu"); the location of the mortuary temple of Ramses III; the ever popular Zipolo Habu Resort in the Solomon Islands; an irritable pit viper species found throughout Asia; some computer in Mississippi; and nearest and dearest to our Air Force hearts, the nickname for the SR-71 aircraft. Dr. Larry Davis, HPCMP Deputy Director, explained that the #1 habu rating means we currently have the biggest capacity for the Program's typical workload, which is pretty impressive!

I'm also pleased with some personnel "enhancements" we've made. Mr. Jeff Graham, long a fixture here at the ASC MSRC, has been appointed to be my able Deputy. (Did you know that Jeff, not as young as he looks, is a huge force for an over-40 soccer team that recently won the 5th annual Pittsburgh Soccer Amateur Open Tournament?) Also, we've recently added Mr. Ron Hannan as Chief of a new Security Division for our Directorate. Ron has extensive knowledge and experience dealing in many aspects of security including personnel, information, facility, information assurance, and export control. These personnel changes will strengthen the support currently in place at the ASC MSRC.

My staff and I are always available to assist you. Let us know how we can serve you better – your opinions are important to us and to the HPCMP.

The Aeronautical Systems Center (ASC) Major Shared Resource Center (MSRC) is a computational science facility supporting Department of Defense (DoD) research, development, and test and evaluation communities with high performance computing and visualization resources. Created as part of the DoD's High Performance Computing Modernization Program (HPCMP), the ASC MSRC High Performance Computing Center is located on Wright-Patterson Air Force Base (WPAFB) and is one of four DoD MSRC sites. Computer Sciences Corporation (CSC) is the prime support contractor at the ASC MSRC.

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ASC MSRC Customer Support
www.asc.hpc.mil
asc.hp.outreach@wpafb.af.mil
Phone: 1-888-MSRC ASC
(1-888-677-2272)

About the cover: Our new masthead graphically combines a bicycle and a sine wave representing our Journal's new name *Wright Cycles*. The sands of Kitty Hawk provide the background of the Wright Brothers first flight. New aircraft designs emerge from the foreground as a result of extensive CFD calculations on the SGI Origin 3900. Thanks to Michael Bruggeman, AFRL/PROE, for providing the 3-dimensional models used on the cover.

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High Performance Computing Enables Development of Versatile Affordable Advanced Turbine Engines

By Steve Gorrell, Air Force Research Laboratory, Propulsion Directorate
Allan van de Wall, General Electric Aircraft Engines
Jay Blair, Computer Sciences Corporation, ASC MSRC

The Air Force Research Lab Propulsion Directorate (AFRL/PR), ASC MSRC and General Electric Aircraft Engines (GEAE) has successfully demonstrated the use of a time-accurate Computational Fluid Dynamics (CFD) code to analyze an advanced compression system. Simulations have been run on a GEAE compressor stage to study unsteady interactions and demonstrate that high performance computing (HPC) is an enabling technology in the development of versatile, affordable, advanced turbine engines. This effort has shown that by combining scalable parallel codes with high performance computers, Modeling and Simulation (M&S) is now capable of providing results in a time frame that may impact the design process. As HPC resources are made available, the capability to develop gas turbine engines is greatly increased and revolutionary technologies may be discovered and transitioned at a faster rate.

This effort is part of the Versatile Affordable Advanced Turbine Engines (VAATE) program, a joint DoD, NASA, DOE, and industry effort focused on a 10x improvement in turbine engine affordability by the year 2017. The VAATE program is focused on the key drivers of engine affordability, which includes activities to increase engine capability, as measured by increased thrust-to-weight and reduced specific fuel consumption. Efforts to reduce all three areas of engine cost: development cost, production cost, maintenance cost are also being addressed.

VAATE will transition turbine engine technology into legacy and pipeline systems, as well as provide propulsion technology to enable advanced aerospace systems.

One of the approaches for meeting compression system objectives for VAATE is the development of efficient, highly loaded compressor stages. Stage loading is a measure of the amount of energy input for a given wheel speed. It is a challenge to combine high stage loading with high efficiency. Government and industry are conducting research that will revolutionize the ability to design highly loaded efficient compressor stages.

M&S of modern, high performance military fans and compressors present a multitude of flow features that must be accounted for in order to accurately predict the performance of the turbomachine. Some examples include wake-blade interactions, wake-shock interactions, wake/shock boundary layer interaction, vortex shedding, and clearance flows. Periodic or full annulus simulations are often required to capture the relevant fluid dynamics. Combined with the desire to model multistage fans and compressors in three dimensions these simulations require parallel machines with large memory storage. Accurately modeling these flow physics require fine meshes for adequate resolution and time-accurate simulations of the unsteady flow features resulting in very long run times and large memory requirements. Time-accurate CFD is the enabling technology that allows the analysis of these unsteady flow features making the high performance computers available at the HPCMP HPC centers a critical resource to the success of the VAATE program.

M&S is a key approach addressing the affordability of turbine engines by reducing the number of design iterations and improving the ability to better predict component performance leading to reduced requirements for expensive engine testing. Not only is HPC critical for compressor development, but also for other components such as the combustor and turbine. Simulation and optimization of the entire engine is also desired.

The CFD program used for the simulations was TURBO. The principal architect is J. P. Chen from Mississippi State University with funding and upgrades provided by NASA Glenn Research Center and GEAE. TURBO is a three-dimensional, viscous, time-accurate code that solves the Reynolds Averaged Navier-Stokes (RANS) equations in the rotating frame of reference. The solution algorithm is an implicit finite volume solver and turbulence modeling is accomplished with a k-ε model specifically developed for turbomachinery flows. Axial communication

between blade rows is through a sliding interface that does not distort the grid.

The TURBO simulations were run on the newly acquired ASC MSRC SGI Origin 3900 supercomputer. *(See articles on Pages 4 and 9 for more information on the SGI Origin 3900.)*

Simulations have been completed for four cases, each case having different boundary conditions. Nine blade passages were modeled in three dimensions requiring a total of 22 million grid points. Figure 1 shows the geometry and grid used for the simulations along with

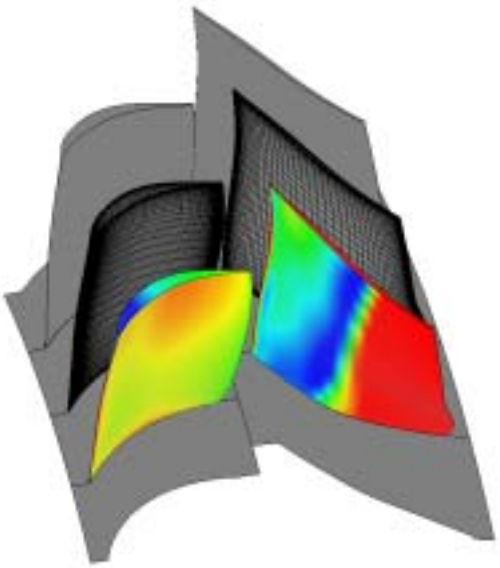


Figure 1. Computational domain and contours of static pressure.

contours of static pressure on the upstream stator and downstream rotor blade surface.

The simulations were run with 212 processors with TURBO demonstrating a parallel efficiency of 95% on the ASC Origin 3900. Approximately 150,000 hours were used during the Pioneer Access program and another 100,000 hours made available from ASC MSRC have been expended for a total of 250,000 hours. A sequence of three snapshots in time of the unsteady solution is shown in Figures 2-4. Figures 3 and 4 are ¼ and ½ rotor blade passing period further in time than Figure 2 respectively. The entropy contours in these figures highlight the complexity of the unsteady flow features able to be captured by unsteady CFD utilizing large massively parallel computers. Notice how the blade wakes from the stator are transported through the rotor. The wakes are cut into segments and reoriented by stretching them in the rotor. This process reduces the loss associated with mixing of blade wakes and is known as wake recovery. By being able to capture and understand unsteady flow processes such as this, intelligent design choices can be made to improve efficiency in modern compressors.

Combining a scalable, parallel code such as TURBO with the HPC resources available at the ASC MSRC, has demonstrated that complex simulations can be completed extremely fast thus allowing time-accurate CFD to be used as a design tool in addition to the traditional analysis role. This effort has demonstrated that when HPC resources are made available to the VAATE community, the capability to develop affordable turbine engines is magnified which will allow critical technologies to be discovered and transitioned at a faster pace. The team is now preparing to run a three stage (seven blade row) simulation to evaluate different design parameters affecting unsteady flows in an advanced compressor to be tested in AFRL's Compressor Research Facility (CRF) in FY04.

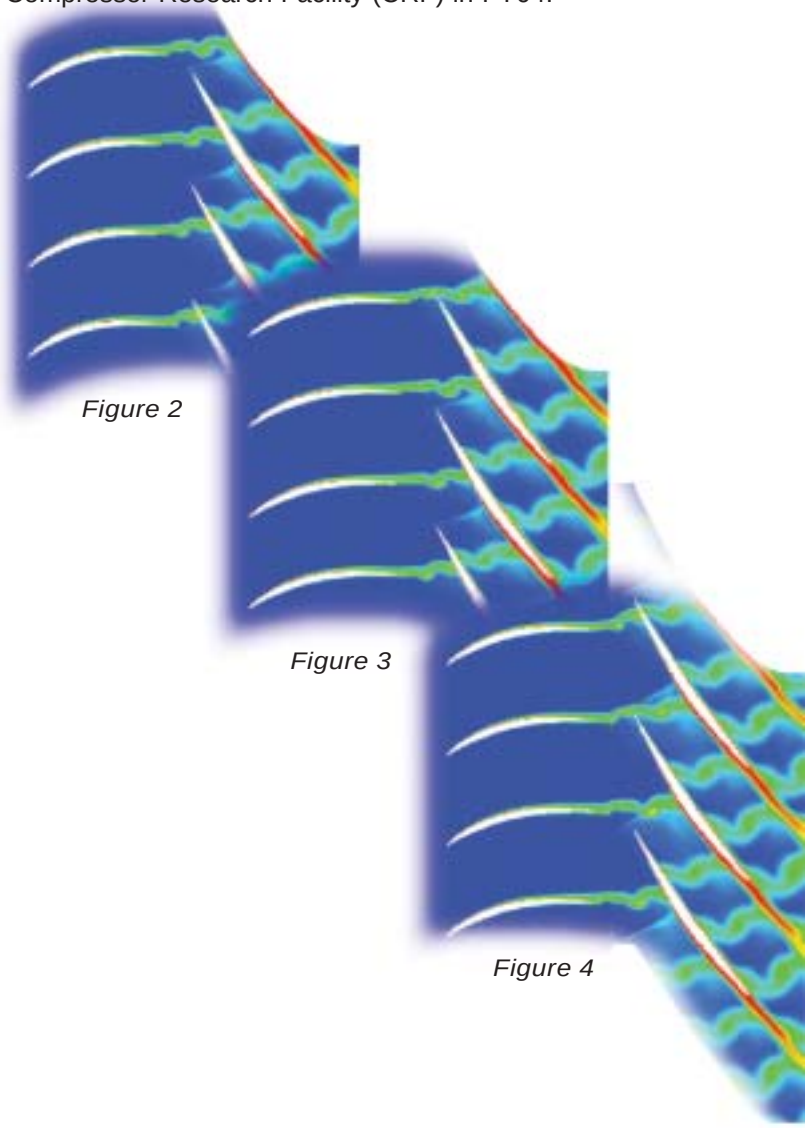


Figure 2

Figure 3

Figure 4

Powerful SGI Origin 3900 Now Available at the ASC MSRC

By Richard Gestrich

The ASC MSRC recently completed the integration and testing of a Silicon Graphics, Inc. (SGI) Origin 3900, 2048 processor complex, which was acquired as part of the Technology Insertion 03 (TI-03) process. All four of the 512-processor systems were in production on August 1. These systems provide over 2.8 teraflops of computing power and 17 million CPU-hours for the Department of Defense (DoD) scientific, engineering and research community. According to SGI officials, this is the largest Origin 3900 installation in the world.

Each symmetrical multiprocessing (SMP) system has 512 700 MHz MIPS processors and 512 GB of memory. Each system runs a single image of SGI's IRIX operating system. The SMP architecture allows for memory to be directly addressable by all processors of a system. The architecture also provides a high-speed communications interconnect that scales with the addition of each processor set to a system. Shared memory and increased bandwidth enable the user's code to quickly share data among processors, allowing for fast, efficient processing.

Data storage is accomplished by an SGI TP9500 Storage Area Network (SAN) that provides 40 TB of disk space. The SAN, combined with SGI's CXFS file system, provides high-speed shared access to data on high-speed storage. Part of the SAN is cross-mounted to the ASC MSRC's existing Scientific Visualization (SciVis) systems using the same CXFS file system. This provides quick access to data that is processed on the SGI Origin 3900 and analyzed with visualization tools on the SciVis systems.

The job submission batch system for the SGI Origin 3900 is Platform Computing's Load Sharing Facility (LSF). In order to provide the users more flexibility in scheduling, it was decided that the primary resource would be the CPU hour (CPH). The CPH is the product of the wall time requested multiplied by the number of CPUs requested. A single user cannot exceed a total of 25,000 CPH or 25 jobs, and can request from one to 508 CPUs for any single job. Four of the 512 CPUs on each system are reserved for IRIX. Currently, users can schedule jobs to run up to 336 hours, as long as they are within the 25,000 CPH limit. These parameters are under constant evaluation to ensure they are set to meet the needs of our users. Current settings can be reviewed at *https://xwww.asc.hpc.mil/overall/policy_procedure/policies/batchqueue.php*.

Integration and testing of the SGI Origin 3900 involved two thirty-day effectiveness level testing periods: a vendor testing period and a pioneer user-testing period. During the vendor-testing period the system capabilities tests were completed. The capabilities tests were used to demonstrate that the systems could each function as an inter-working system and that the guaranteed TI-03 benchmark execution times could be met. Individual tests were conducted on the systems to verify the compilers, software tools, networking, and batch job submission system operations. The SAN was tested for throughput and industry standard benchmarks were run to check timings. For the thirty-day pioneer testing period a group of pioneer users were chosen who stressed the system with real world codes, the same that would be used in a production environment. The system passed both effectiveness level testing periods, meeting the required uptime, load average, and interrupt requirements. The ASC MSRC also had the opportunity to demonstrate the capabilities testing to the Joint Interoperability Test Command (JITC), which reviewed the acceptance test plan and witnessed the capabilities tests. By validating our test plan JITC increased our confidence the system was ready for production.

The SGI Origin 3900 is a welcome addition to the computational resources of the ASC MSRC, and will provide our users with the computational power that is needed now and into the near future. Additional information about the ASC MSRC and its computing resources can be found at *www.asc.hpc.mil*.

The ribbon cutting for the SGI Origin 3900 was held on October 6. Lieutenant General Richard V. Reynolds, ASC Commander, hosted the event, and Mr. David Rothery acted as Master of Ceremonies. Attendees included U.S. Representative David Hobson; Mr. Bob Bishop, CEO of SGI, Inc.; plus a number of representatives from the federal and state government, Wright-Patterson AFB, academia, and industry. Press coverage included two local television stations, AFMC's *Leading Edge*, and the WPAFB weekly newspaper, *Skywrighter*.

Photos courtesy of Al Bright, WPAFB Multimedia Center.

"We're very fortunate to have this remarkable capability at Wright-Patterson."

Lt Gen Reynolds

DREN to Lead DoD in IPv6 Implementation

By Ralph McEldowney

On June 9, 2003, John P. Stenbit, the DoD Chief Information Officer (CIO), announced that the Department would complete a transition from the current Internet Protocol version 4 (IPv4) to the next generation Internet Protocol version 6 (IPv6) by 2008. According to Stenbit, "Adoption of the new standard also promises to expand availability of IP address space, improve end-to-end security, facilitate mobile communications, enhance quality of digital services, and ease system management."

The effort required to move from IPv4 to IPv6 will be large. However, rather than re-invent the Internet, most systems will be enabled to access both protocols simultaneously, until IPv4 slowly disappears. The level of effort will be similar to the Y2K project of a few years back, and it will take time. In fact, the DoD has developed a four year schedule to complete the transition, but that's only if we start today!

Why IPv6? Doesn't IPv4 do everything we need it to do? Why implement a new technology if the existing one isn't broken? While it's true that IPv4 has served the Internet well and many changes have been made to fix technical problems and add new capabilities, it's also true that IPv6 is the future of networking. The new features in IPv6 will enable greater security, mobility, and scalability.

One of the problem areas in IPv4 is the number of network addresses available. With IPv4 there are 4 billion addresses, but most of them have already been assigned. In IPv6 there are 3.4×10^{38} addresses. That's enough for each square foot on the earth's surface to have thousands of usable addresses!

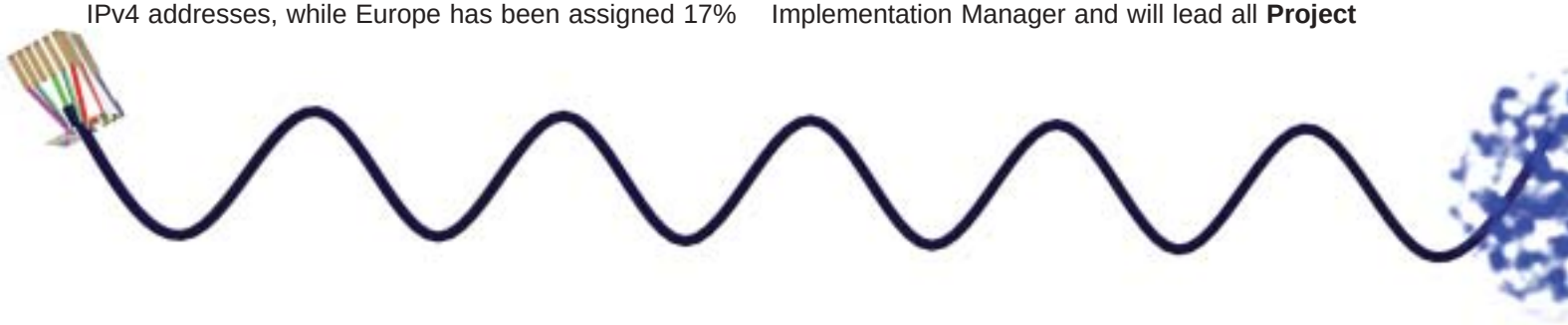
In addition to the smaller number of addresses available, IPv4 address allocations have also been a problem. North America has been assigned 74% of all IPv4 addresses, while Europe has been assigned 17% and Asia only 9%. Countries such as Japan, China, and India do not have the IPv4 addresses they need. In fact, most of Asia and Europe have already embraced IPv6 and have transitioned significant portions of their networks. North American networks and network vendors may be technologically "left behind" if we don't start embracing IPv6 too.

IPv6 also promises greater security by including an IPSec encryption algorithm for data transmitted between two devices. IPv4 has no provision for data encryption, except at the application layer. IPv6 requires this capability, resulting in more secure data communications.

The Defense Research and Engineering Network (DREN) has been selected by the DoD CIO to participate in a pilot IPv6 implementation project in FY2004. DREN will be one of two pilot networks, along with the Defense Information System Network Leading Edge Services (DISN-LES). The DREN IPv6 pilot project will address all aspects of the network, including the backbone, services, security, management, and applications.

In July 2003, Rodger Johnson, the DREN Project Manager, challenged the DREN Technical Advisory Panel (TAP) to develop an IPv6 Implementation Plan and then implement it over the next year. The TAP then identified several major areas of effort, created teams to tackle each area, and assigned a different TAP member to lead each team. As a result, the following teams have been created: IP Transport, Infrastructure Services, Network Management, Security, Applications, HPC Community Involvement, and Project Management.

John Baird, from the Space and Naval Warfare Systems Center (SSC) San Diego, was named the Implementation Manager and will lead all **Project**



Management initiatives. John has been coordinating with the team leads to develop a comprehensive DREN IPv6 Implementation Plan. This Plan includes a comprehensive task breakdown structure, task completion dates, and an estimate of the resources required to accomplish each task.

The **IP Transport Team** will be led by ***Ron Broersma***, also from SSC San Diego. This team will be responsible for enabling IPv6 on the DREN backbone, establishing connectivity with other IPv6 research networks, and creating protocol gateways between IPv4-only and IPv6-only networks. This team will also interact closely with network router and switch vendors to ensure that necessary IPv6 features are available in their products.

Phil Dykstra, of WareOnEarth Communications, will lead the **Infrastructure Services Team**. This team will be responsible for investigating and recommending IPv6 solutions for Domain Name Servers (DNS), the Dynamic Host Configuration Protocol (DHCP), the Network Time Protocol (NTP), the Simple Message Transfer Protocol (SMTP), and the suite of Active Measurement Program (AMP) tools used for DREN performance analysis.

The **Network Management Team** will be led by ***Tom Kile*** from the Army Research Lab. This team will investigate and recommend IPv6 solutions for the tools used to manage networks. These tools are usually based on the Simple Network Management Protocol (SNMP) and include Looking Glass, Multi-Router Traffic Grapher (MRTG), the DREN Consolidated Network Information Center (CNIC), and commercial products such as Dartware Intermapper, HP Openview, Ipswitch What's Up, and CA Unicenter. This team will also assist the DREN Network Operations Center (NOC) with its IPv6 transition.

Doug Butler from the HPCMPO will lead the **Security Team**. This team will focus on the IPv6 capabilities of security devices, tools, and processes. The devices and tools include Network Intrusion Detection Systems (NIDS), Firewalls, Kerberos Key Distribution Servers (KDCs), vulnerability scanning tools, IPSec encryption devices, and Access Control Lists (ACLs). They will recommend changes in security processes such as accreditation packages and Comprehensive Security Assessments (CSAs). This team will also assist the HPC Computer Emergency Response Team (CERT) with its IPv6 transition, and interface with network security vendors to ensure that IPv6 features are available in their products.

The **Applications Team** will be led by ***Ralph McEldowney*** from the ASC MSRC. This team will focus on enabling IPv6 capabilities in user and support applications. User applications include the Kerberos suite (ktelnet, kftp, krcp, etc), the ssh suite (ssh, scp, sftp), third-party commercial software, government developed software, open source software, and the Common HPC Software Support Initiative (CHSSI) applications. Support applications include compilers, debuggers, batch queue systems, file systems, the Information Environment (IE), and the On-line Knowledge Center (OKC). This team will work with major application vendors and software developers to ensure that IPv6 capabilities are enabled in their codes.

John Baird will also lead the **HPC Community Involvement Team**. This team will provide IPv6 transition information to the DREN and HPCMP communities. They will develop websites and information briefings, provide IPv6 training, and assist DREN sites with their own transitions. This team will also collect the lessons learned and best practices, and share them with the entire DREN community.

IPv6 is the future of networking, and the future is now. The DoD can't wait another decade to get serious about IPv6, just because we have enough IPv4 addresses. It is time to implement dual stack IPv4/IPv6 networks. We do not want to be technologically "left behind". It won't be easy, but the DREN community will lead the way, and the lessons learned will be shared with all.

For additional information about IPv6, visit the following websites*: www.ipv6.org, www.ipv6forum.com, www.6bone.net,* and *www.6ren.net.*

Software: Key Facet of the ASC MSRC

By Jay Blair

There is a little known fact about the ASC MSRC. There are approximately 70 commercial off-the-shelf (COTS) software applications installed and available to our users. This includes software from several of the major commercial vendors of the following Computational Technology Areas (CTAs): Computational Structural Mechanics (CSM), Computational Fluid Dynamics (CFD), Computational Chemistry and Materials Science (CCM), Computational Electromagnetics and Acoustics (CEA), Computational Electronics and Nanoelectronics (CEN), and Signal Image Processing (SIP).

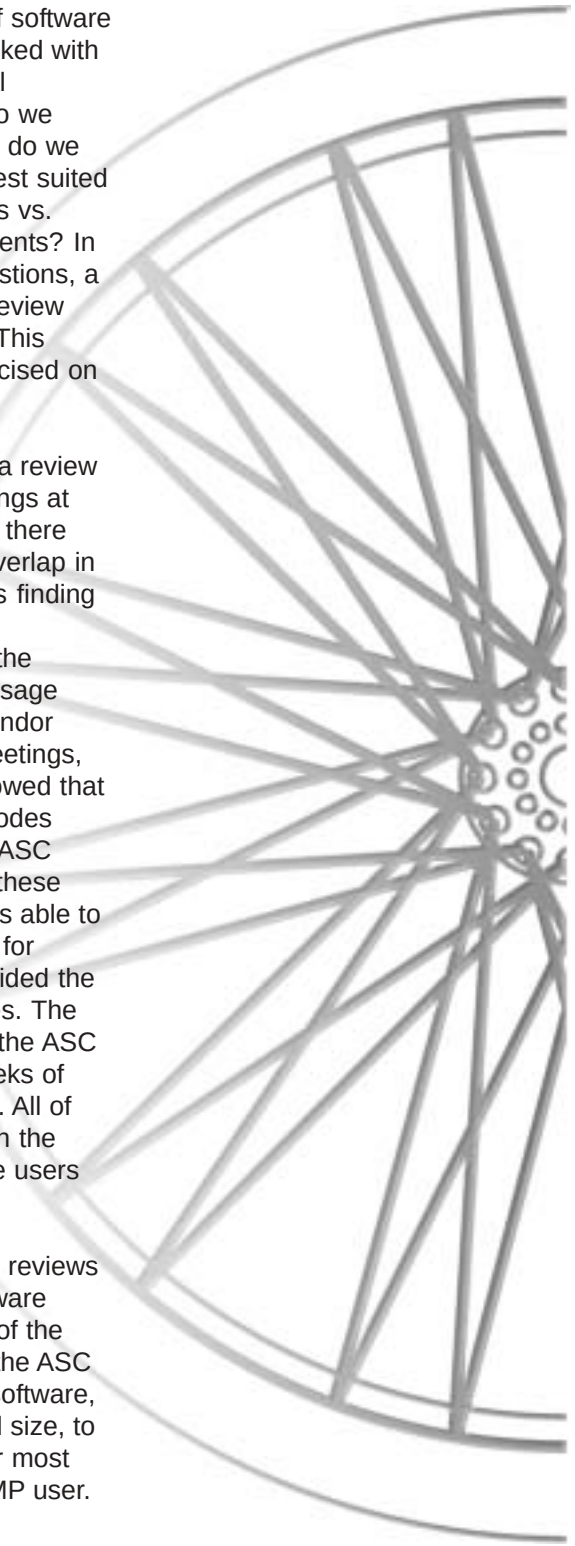
The ASC MSRC strives to be at the forefront in providing leading edge hardware and cycles to the HPCMP user. We also strive to provide the same commitment to software.

To accomplish this task a new focus group has been formed, the Software Management Team (SMT). The SMT consists of personnel representing the various components at the ASC MSRC, which includes Application Managers, Business Office, Outreach, Program Environment and Training (PET), Security, Systems Administration, Test and Development Environment (TADE), and User Services. The goal of the SMT is to develop the processes by which software is managed at the ASC MSRC. This management has several facets including software acquisition, software retention and software removal.

With the size and scope of software that the SMT has been tasked with maintaining comes several challenges. What codes do we need? How many licenses do we need? Which codes are best suited for HPC-type environments vs. workstation-type environments? In order to answer these questions, a comprehensive software review process was established. This process was recently exercised on the CSM software.

Over the course of a year a review of the CSM software offerings at the ASC MSRC found that there was significant software overlap in functional capabilities. This finding was based on user-driven benchmarks submitted to the individual CSM vendors, usage statistics, user surveys, vendor technological roadmap meetings, and costs. This review showed that the removal of two CSM codes would be beneficial to the ASC MSRC user. By removing these codes, the ASC MSRC was able to secure additional licenses for existing software that provided the same functional capabilities. The cost savings also allowed the ASC MSRC to offer several weeks of training for the CSM users. All of this was accomplished with the assistance and input of the users and PET personnel.

The SMT plans to conduct reviews of the remaining CTA software applications. It is the goal of the SMT to make certain that the ASC MSRC has leading-edge software, both in terms of scope and size, to meet the challenges of our most important asset: the HPCMP user.



SGI Origin 3900 Pioneer Access Program

By Jay Blair

pi·o·neer (pi´ ə-nîr´) n. -
1. One who ventures into unknown or unclaimed territory to settle.
2. One who opens up new areas of thought, research, or development: *a pioneer in aviation.*
3. A soldier who performs construction and demolition work in the field to facilitate troop movements.

While the above definitions can be applied to all HPCMP researchers, they recently applied to a group of select users at the ASC MSRC. These users were invited to be among the very first to run on one of the largest machines in the HPCMP as part of the 5th ASC MSRC Pioneer Access Program.

The newest member of the HPC environment consists of four separate Silicon Graphics, Inc. Origin (SGI) 3900 512 CPU systems, each with 512 GB of available memory. Platform Computing's Load Sharing Facility (LSF) is used for batch scheduling and the largest queue is 508 CPUs. The workspace is 40 TB and is CXFS-mounted across all four system images. *(See related article on Page 4.)*

On May 23, 2003 the ASC MSRC started the Pioneer Access Program for the new machine. The Pioneer Access Program is a mutually beneficial arrangement between the ASC MSRC and its users. Pioneer users had an opportunity to get time on a machine, free of allocations. Many of our pioneer users participated in the program to check out their codes or scripts before allocated usage began. Users also benchmarked performance to decide how many hours to request for the upcoming fiscal year (FY04). The activities of the pioneer users helped stress test the systems to ensure they were ready for production.

The program was split into three waves of users over a two-month period. The first wave consisted of 20 users and ran from May 23rd to July 31st. Wave two added 10 additional users on the 30th of May and wave three added the last 10 users on June 5th.

During the course of the program over 40 users logged on and utilized the system. In all, over 940,000 hours were used during the two-month period. Several users ran jobs in excess of 200 CPUs at one time: Dr. Phillip Morgan (AFRL/VAAC) scaled FDL3Di up to 508 CPUs; Joe Metzger (NRL) scaled HYCOM up to 506 CPUs; Drs. Monty Moshier and Ron Hinrichsen (46 OG/OGM/OL-AC) scaled LS/Dyna up to 256 CPUs; and Dr. Steve Gorrell (AFRL/PRTF) scaled TURBO up to 212 CPUs. Users also successfully compiled and ran both MPI and OpenMP for 32-bit and 64-bit codes.

The pioneer users were instrumental in ensuring the machine was ready for full production on August 1, 2003. If you would like FY04 allocations on this system, please contact your S/AAA. For more information call the ASC MSRC Help Desk at (888) MSRC ASC (677-2272) or email at *msrchelp@asc.hpc.mil*.

New CTA On-sites Named

By Brian Schafer

The ASC MSRC welcomes Dr. Rhonda Vickery as the PET on-site lead for Enabling Technologies (ET). She is employed by Mississippi State University, supporting Dr. Robert Moorhead, the PET Functional Area Point of Contact (FAPOC) for ET.

Rhonda graduated from Mississippi State University with a Ph.D. in Computational Engineering, after successfully defending her dissertation in early July. Rhonda's research focused on developing advanced immersive visualization techniques that allow researchers to better understand sediment transport (ST) models. These models are used to study the burial and visibility characteristics of suspended sediment in littoral (shallow water) regions. Her work has been presented in a number of publications and conferences.

Rhonda began her career as an engineer with General Dynamics Fort Worth in 1984, serving as a systems manager of a large VAX station cluster and file servers. She was very involved with the design of the implementation, software development, and testing in JOVIAL and Fortran for flight control computer system on the digital F-16. This experience led to designing the implementation and software development in Ada and Assembly for dual processor flight control computer system on the A-12 stealth aircraft.

In 1991, Rhonda and her family moved to Mobile, Alabama where she was a senior computer systems engineer at Scott Paper Company. She coordinated computer systems development and integration with personnel in all phases of paper manufacturing and was responsible for computers in three paper mills. While living in Mobile, Rhonda earned a Masters Degree in Computer and Information Science in 1994 at the University of South Alabama.

Rhonda then joined Mississippi State University, as a research assistant and later became a research associate, while pursuing her Ph.D.. She specialized in scientific visualization (SciVis) and computer graphics, including visualization and high performance rendering of sedimentation models in a virtual reality four-wall CAVE environment. Rhonda designed and implemented a multiple interface visualization application in C++ to support research into new algorithms for visualization and rendering, as well as usability studies in virtual reality environments. Besides the CAVE, versions of this application can run on multiple SGI platforms, and in the future, Linux PC platforms. Other software development toolkits integrated as part of this application include CAVELibs, OpenGL, VTK, vwLib, and netCDF.

As a PET ET on-site, Dr. Vickery is involved with advancing the state of tools, algorithms and standards for generalized pre- and post-processing analysis on very large datasets. This includes, but is not limited to: SciVis, data mining and knowledge discovery, image analysis, grid generation, problem solving environments (PSEs), and computational techniques and methods for intelligent extraction of useful information from data. Away from the office, she enjoys spending time with her family and participating in a variety of outdoor recreational activities, including biking, skating, skiing, hiking, and camping.

Dr. Vickery can be reached via email at *Rhonda.Vickery@wpafb.af.mil*.

Dr. Steven Wong has been named the PET on-site lead for Computational Electromagnetics and Acoustics (CEA) at the ASC MSRC. He is employed by High Performance Technologies, Inc. (HPTi) supporting Prof. Jianming Jin, the PET Functional Area Point of Contact (FAPOC) and Prof. Charbel Farhat (Co-FAPOC) for CEA.

Dr. Wong received his Ph.D. in Electrical and Computer Engineering from Carnegie Mellon University 1989, specializing in Computational Electromagnetics. Upon graduating, he joined General

Electric Medical Systems as an Electromagnetics Engineer. His responsibilities included the electromagnetics design of superconducting MRI magnets for whole body imaging. He also served as the principal electromagnetics designer for three generations of GE's 1.0 Tesla and 1.5 Tesla MRI magnets.

In 2000, Steven left GE and became a member of software development team for Internet start-up Privista's e-commerce web site. His duties involved the development and maintenance of the company's main product "Identity Guard" processing software as well as applications in e-commerce transaction batch processing, DB2 applications in C, Unix and embedded SQL. Other duties included front-end web programming using Java and JSP.

Before joining the PET Staff, Steven joined the scientific programming staff at Telecom/Photonics start-up MadMax Optics. He was in charge of the integration and application development of the company's Microstructure Optical Fiber (holey fiber) simulation software suite. He also integrated the backend Integral Equations Mathematical libraries development with the front-end graphical user interface using Fortran, C, Linux and Matlab.

As a PET CEA on-site, Dr. Wong helps provide high-resolution, multi-dimensional solutions of Maxwell's equations and acoustic wave equations. Uses include calculating fields about antenna arrays; signatures of tactical ground, air, sea, and space vehicles; the signature of buried munitions; performance/design factors for electromagnetic gun technology; high-power microwave performance; modeling of acoustic fields for surveillance and communication; seismic fields for mine detection; and acoustic shock waves of explosions for antipersonnel weapons.

In his spare time, Steven enjoys spending time with his family and playing with his two sons, ages 5 and 3.

Dr. Wong can be reached via email at *Steven.Wong@wpafb.af.mil*.

Summer Intern Program

By Bill Zilliox

In 1998, the ASC MSRC PET Program provided summer internships for six undergraduate students as part of its outreach initiative to colleges and universities. Since then, more than fifty students from twenty-eight institutions across the country have spent their summer months working at the ASC MSRC. The interns have gained practical work experience in information technology, modeling and simulation, scientific visualization and computational science.

The goal of the HPCMP PET Summer Intern Program is to acquaint undergraduate and graduate students with high performance computing technologies and DoD research activities in order to encourage them to consider careers in this challenging field. For ten weeks each year, with the help of mentors from the on-site PET team or the ASC MSRC staff, students are given the opportunity to complete meaningful projects in a timely and professional manner. They often work closely with local DoD users, leveraging the hardware and software resources of the MSRC while enhancing their problem solving, programming and communication skills. At the conclusion of the program, students give formal presentations describing the assigned problems and the solution methods, and demonstrating their accomplishments. The interns are also encouraged to provide feedback and suggestions to program administrators, which can be factored into program improvement plans.

In the summer of 2003, the ASC MSRC hosted eight interns. According to Jeff Graham, Deputy Director ASC MSRC, "This year's crop of interns was amazing. The work these young men and women performed in a short period of time, their plans for the future...was great! I predict this group is going to do some wonderful things for our world in the future."

The Summer Intern Program is clearly a "win-win" proposition, providing some of the best and brightest students an outstanding work experience, and providing the DoD user community improved HPC tools and techniques.

Contact Bill Zilliox at *william.zilliox@wpafb.af.mil* or Sharron Madero at *sharron.madero@wpafb.af.mil* for more information about the Summer Intern Program.

SUMMER INTERNS "2003"

Alexi Girgis

Ian Bachus

Lisa Shahady

James Bittle

Tomekia Simeon

Ryan Glasby

Michael Suever

Ross Smith

Mentors

Worcester Polytechnic Institute
Optics

Project: Wavefunction Engineering: Design of Terahertz Quantum Cascade Lasers

Stark State College of Technology
Computer Science and Engineering

Project: *Distributed Simulations*

Bowling Green State University
Visual Communication Technology

Project: *Virtual Tour*

Case Western Reserve University
Mechanical Engineering

Project: *Baseball Bats: Finite Element Analysis; Modeling MANPADS Missile*

Jackson State University
Computational Chemistry

Project: *Computational Analysis of Platinum Oligomers and Polymers Ground States and Triplet States*

The Ohio State University
Aeronautical Engineering

Project: *Flapping Wing Flight*

Ohio Northern University
Computer Science

Project: *Polygon Simplification*

Rose-Hulman Institute of Technology
Mechanical Engineering

Project: A *Tale of Two CFDs*

FY04 PET Projects Announced

By Brian Schafer

The Programming Environment and Training (PET) Component 2, hosted at the ASC MSRC, is responsible for gathering and deploying the best ideas, algorithms, and software tools emerging from the national high performance computing infrastructure into the DoD user community. One method to achieving these goals is through the selection of projects that will benefit our user community. In October 2003, work began on the following PET projects:

Signal/Image Processing (SIP)
Dr. Stan Ahalt, POC
Ohio Supercomputing Center

High Productivity Computing (HPdC) for SIP
This project continues the effort on high-level, life cycle software tools including MATLAB, parallel technologies such as MPI and MatlabMPI, middleware protocols and standards such as VSIPL and High Level Architecture (HLA), next-generation high end programming environments (e.g., Octave, Python, and Titanium), and alternative technically- and economically-viable HPdC solutions for SIP.

Support for Automatic Target Recognition (ATR) Programs
A study of compressed parameterized model data over a range of squint angles and azimuths will be included in this effort. Also included is a study of the effects of various environmental conditions on ATR performance when exploiting hyperspectral imagery operating over a number of different bands, and the extension of XML annotation techniques for sequential-frame ATR video that supports high-level syntactic and statistical descriptions of video data.

Signal Mining, Fusion and Validation
This effort involves technology transfer of existing algorithms in the form of HPC code for Signal Mining and Exploitation to develop code, which is common across the different sensing modality (such as clustering, for example), as well as code that is specific to the sensing modality involved (such as acoustic signal processing.)

Integrated Modeling and Test Environments (IMT)
Dr. Ashok Krishnamurthy, POC
The Ohio State University

** Final approval for the IMT projects still pending.*
Real-Time Testing Operations using MATLAB and Simulink
MATLAB and Simulink are widely used in the Modeling and Testing community, both for building models used in simulation, and for pre- and post-processing test data. Many test operations require that the models be run in real-time and that the post processing for test data validation be done as quickly as possible, preferably in real-time. This effort concentrates on parallelizing and running MATLAB and Simulink models and codes in near real-time on HPCs.

Database Repository Using Federated Databases
The same components and systems are frequently tested at different test locations. It is useful for a test engineer to have access to data and metadata about previous tests. Unfortunately, test data and metadata are typically stored in individual databases at the testing location. This project will investigate the development of a data repository that federates multiple test databases and provides a uniform way of accessing test data from diverse locations.

Enabling Technologies (ET)
Dr. Robert Moorhead, POC
Mississippi State University

Domain Independent Feature Detection
This project will develop a set of tools constructed as separate modules that plug into a common interface that conducts both domain dependent (DD) and domain independent (DI) feature detection.

Error Indicators and Reliability Software for DoD Applications
A class of error indicators and supporting algorithms that are independent of the underlying DoD application will be developed and implemented in a software module that can be linked to different DoD user codes, providing assessment of the reliability of a calculation and graphical output.

Forces Modeling and Simulation/C4I (FMS)

Dr. David Pratt, POC

Science Applications International Corporation (SAIC)

An Environment for Multiple Concurrent Constructive Model Runs

This project addresses two critical issues limiting the exploitation of HPC resources by the FMS community: job initiation and security. By taking advantage of the HPC multi-processor architecture and an automated way of starting and managing jobs, we can reduce the manual overhead, and thus the sequential nature, of running many FMS codes. Currently, many of the FMS codes are run in a system high environment, limiting both the places and resources that can be used. By leveraging the security and remote job interaction and control mechanisms in use at the MSRCs, we are looking to increase both the security and flexibility of the codes.

Polygon Decimation Process for Threat / Target Models for Virtual Simulation

To create, display and effectively use realistic synthetic battle space environments requires managing the complexity of the objects within the scene in multiple modalities. These battle space environments are used in constructive and virtual simulation in applications such as weapon system design, vulnerability analysis, and test and evaluation. Traditionally, creating models with levels of detail and with agreement in different spectral bands is a time-consuming process dominated by human effort. We propose an automated process for taking high fidelity polygonal models of battlefield objects and reducing the polygon count while at the same time maintaining multi-spectral agreement.

For more information about these projects, or PET in general, contact Brian Schafer at *Brian.Schafer@wpafb.af.mil* or Bill Zilliox at *william.zilliox@wpafb.af.mil*.

New Command Chief Visits ASC MSRC

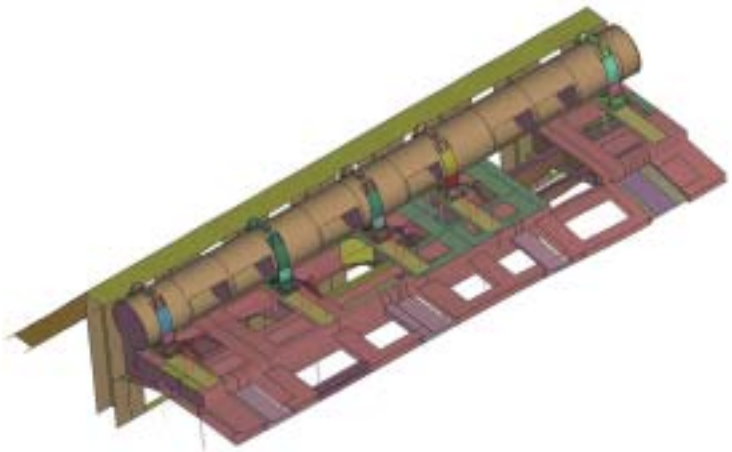
The ASC MSRC was honored to host the Commander of the Air Force Materiel Command, General Gregory S. Martin on October 23rd. The Commander of the ASC, Lieutenant General Richard V. Reynolds, accompanied General Martin during a tour of the MSRC, which highlighted the productivity derived from our full service capabilities. Short overviews of successful weapon system-related efforts were provided by Dr. Hugh Thornburg and Dr. Ron Hinrichsen. Mr. Randy Pargman employed his queue visualization tool to demonstrate timely and effective flow of critical DoD Modeling and Simulation jobs. A vibrant question and answer period at all stops on the tour showed a high interest level from both Gen Martin and Lt Gen Reynolds.

User Success Story: Naval Undersea Warfare Center

By Juan C. Cruz, Naval Undersea Warfare Center

The increasing costs of performing underwater explosion (UNDEX) shock and survivability tests of submarine structures and payloads, has prompted the United States Navy to look for alternatives to reduce the costs associated with these tests. An alternative currently being put to the test by the Navy explores the feasibility of taking advantage of the capabilities of transient, dynamic Finite Element Analysis (FEA), to substitute large-scale shock tests so that qualification by analysis could be achieved.

Such an approach would require models to have a great amount of detail and, along the way, several different mesh refinements would be needed in order to yield a high confidence, converged solution. These requirements had great implications; if a customer approached us with a task that would require qualification by analysis with an accelerated schedule, it would be almost impossible to do the job on our in-house computer system. And such a customer showed up…



Cylinder simulating a payload stowed on the outboard structure of a submarine.

The new customer's job required a larger and faster resource that would enable our team of analysts to make multiple runs at a time, with shorter turnaround times, and as often as it would be required by the program. In March 2002, we were given the opportunity to access the resources at the ASC MSRC and started using the Compaq GS-320 and SC-40/45 machines for our LS-DYNA3D and ABAQUS analysis needs.

The early stages of this new endeavor were a bit difficult, since models sometimes had to be revised and/or modified so that they could run to completion. However, with a lot of patience and the exceptional support from the ASC MSRC staff, analysis runs that would otherwise take weeks to solve were soon running with great reliability and at blazing speeds. This improvement in model execution enabled our shock and survivability analysis team to turnaround multiple models at a time in a matter of hours (and sometimes even minutes). Additionally, our team was able to develop an advanced, high-quality analysis capability for the benefit of our customers.

Our team and current customers are extremely pleased with the performance of the ASC MSRC's high performance computing resources, and we look forward to using this valuable resource again in the future.

For more information please contact the author via email at *cruzjc@npt.nuwc.navy.mil*.

FY04 Challenge Projects

The High Performance Computing Modernization Program allocates approximately 25% of its HPC resources each fiscal year to competitively selected DoD Challenge Projects. These computationally intensive, high-priority projects are selected annually through a rigorous technical and mission relevance evaluation. Senior scientists and engineers within Defense Science and Technology (S&T) and Test and Evaluation (T&E) communities, universities, and industry research partners head these high-priority projects. These projects take advantage of extensive HPC capabilities at the MSRCs and Distributed Centers.

Challenge Project efforts produce and support key enabling technologies, capabilities, and demonstrations expressed by the Defense Technology Objectives (DTOs). These enabling DTOs support Joint Vision 2020 and the thirteen Joint Warfighting Capability Objectives (JWCOs) promulgated by the Joint Requirements Oversight Council of the Joints Chiefs of Staff.

In July, the HPCMP announced FY04 challenge projects. Eight of the thirty-four projects will run at the ASC MSRC.

Returning from FY03

- High Fidelity Analysis of UAVs Using Nonlinear Fluid/Structure Simulation
  Principal Investigator: Dr. Reid Melville, Air Force Research Laboratory
- Multiscale Simulations of High Energy Density Materials
  Principal Investigator: Dr. Jerry Boatz, Air Force Research Laboratory
- Three-Dimensional CFD Modeling of the Chemical Oxygen-Iodine Laser II
  Principal Investigator: Dr. Timothy Madden, Air Force Research Laboratory
- Defense Against Chemical Warfare Agents (CWAs) and Toxic Industrial Chemicals (TICs): Filtration, Prophylaxis, and Therapeutics
  Principal Investigator: Dr. Margaret Hurley, Army Research Laboratory
- Multidisciplinary Applications of Detached-Eddy Simulation to Separated Flows at High Reynolds Numbers
  Principal Investigator: Major Scott Morton, Air Force Academy

New in FY04

- Three-Dimensional Modeling and Simulation of Weapons Effects for Obstacle Clearance
  Principal Investigator: Dr. Alexandra Landsberg, Naval Surface Warfare Center
- Computational Simulations of Combustion Chamber Dynamics and Hypergolic Gel Propellant Chemistry for Selectable Thrust Engines in Next Generation Guided Missiles
  Principal Investigator: Dr. Michael Nusca, Army Research Laboratory
- Hybrid RANS-LES for High Fidelity Simulation of Circulation Control Schemes for Navy Applications
  Principal Investigator: Dr. Robert Kunz, Office of Naval Research

Information Environment Provides Uniformity Across HPCMP Centers

By Ann Ware

The HPCMP has implemented a secure, web-based system for managing its computing resources: the Information Environment (IE). The IE system provides the HPCMP community with an application that provides seamless access to distributed relational data, improved information sharing/gathering among HPCMP associated sites, and standardized data exchange/reporting. IE also integrates data into a common information architecture that contains user contact, project, allocation, utilization, and queue status information.

In preparation for completing the IE account application form you should be ready to provide the following information:

- Name, Title, Position
- Mailing Address (no P.O. boxes), Phone, Fax
- Email Address
- HPCMP Organization
- Citizenship Status (alien registration number and expiration date - where applicable)
- Government Employee Status
- Government Point of Contact (POC) (non-government employees)
- Contact Information, Contract Number, and Contract Expiration Date
- Organization Hierarchy and Position (optional)
- National Agency Check (NAC) status (if known)
- Preferred User ID (optional - where permitted)
- Preferred Shell (optional - where permitted)

The IE account application form contains the same fields as a Service/Agency Approval Authority (S/AAA) Section II Account Request Information form. IE centralizes this information for HPCMP users so that S/AAAs can generate Section II information from IE and combine it with Section I information for completed project packets.

Intending HPCMP users will be notified by their S/AAA or Principal Investigator (PI) with instructions on how to access the IE account application page. Detailed instructions can be found in the CATC User Tips Quick Reference Guide at *https://xwww.asc.hpc.mil*. Following the instructions, users can apply for an account on the IE system. Once the application has been completed and submitted, the application will be forwarded to the appropriate authorities for approval. Users will receive email notification upon approval. When the account processing has been completed an email will be sent from the appropriate center.

If you have questions, or would like more information, please contact the ASC MSRC Service Center at 1-888-677-2272, or via email at *msrchelp@asc.hpc.mil*.

The Essentials of Customer Support

By Dan Schornak

As the ASC MSRC continues to evolve in terms of high performance computing capability, so too does the approach to delivering premier customer support to its users. Placing the "User First" is not only our motto, but also the foundation of the Center's support structure. The Customer Assistance, Accounts, and Computational Technology Centers were recently combined to form an integrated service organization, the Customer Assistance and Technology Center (CATC).

This new structure affords the ASC MSRC the ability to create a user-centric support structure that has a well-defined mission statement within each of its functional areas of Accounts, Service Desk, Outreach, and Computational Technology.

Accounts Mission Statement

Enable DoD researchers to meet their high performance computing requirements by providing access to the ASC MSRC high performance computing environment.

Outreach Mission Statement

Inform and bring awareness to DoD researchers and the public-at-large regarding the benefits, capabilities, and possibilities in using high performance computing and scientific visualization.

Service Desk Mission Statement

Guide the DoD researcher in the processes and operation of the ASC MSRC to expedite DoD research.

Computational Technology Mission Statement

Encourage and assist DoD researchers to utilize high performance computing and scientific visualization resources to meet research objectives.

Helping Us, Help You - When working to identify the cause of a runtime failure for a user's job, the importance of capturing pertinent details and information cannot be over emphasized. Users are encouraged to always define a standard error file within their batch script files. Information collected in these error files can provide a great deal of insight into the job flow up to the point of failure. Examples of how to create an error file can be found on our web site at *https://xwww.asc.hpc.mil/customer/userdocs/samples/samplebatch.php*.

Since many HPC users write their own code, the ASC MSRC offers coding assistance to those who are having difficulty either converting their serial codes to parallel codes, migrating their codes from one HPC platform to another, or just running their code on a particular platform. If you have questions regarding this service, please contact the CATC (*msrchelp@asc.hpc.mil*).

Got any "how do you…" questions? Our most popular documents are our Quick Reference and system user guides. Please checkout our available documentation at *https://xwww.asc.hpc.mil/customer/userdocs/index.php*. If you don't see what you need, please contact us and let us know.

ASC MSRC Welcomes New Staff Member - With the introduction of the world's largest SGI Origin 3900 system, a new application analyst has joined the ASC MSRC team to provide focused support for users of this system. No stranger to either high performance computing or the ASC MSRC, Rick Roberts rejoins the support team as a CSC employee. Rick is dedicated to delivering ease-of-use methods and approaches for the users of this new platform. He was previously an SGI Application Analyst at the ASC MSRC during the days of the SGI Origin 2000. Within the HPCMP, Rick has been a mainstay, working in previous assignments at ERDC MSRC in Vicksburg, Mississippi, NAVO MSRC at Stennis Space Center, and NRL DC in Washington, D.C. Welcome aboard Rick!

EAAGLES – Virtual Simulation

By Randyll Levine and Timothy Menke, ASC/HPEN

The Advanced Computational Analysis Directorate's Simulation and Analysis Facility (SIMAF), located at Wright-Patterson AFB, Ohio, excels in virtual modeling, simulation and analysis (MS&A). Using virtual simulation, also called real-time and human-in-the-loop simulation, together with constructive MS&A, SIMAF leverages the expertise of warfighters, engineers, and analysts to further advance the research, development and use of current and future weapons systems.

This summer, four SIMAF cockpits made a public appearance at Students Open to Aviation Research (SOAR), a program that provides underprivileged students access to science and technology in the hopes of inspiring them to pursue degrees in math and science, and also at the 2003 Dayton Air and Trade Show Aerospace Adventures exhibit. Over five days, hundreds of students "flew" an F-16 through hills, valleys, and open skies. While the exhibit was designed to help spur student interest in science and math, it allowed SIMAF to give the public a glimpse of an emerging capability to support Air Force modeling and simulation in the very near future.

In June 2002, SIMAF was directed to begin working infrastructure development with the USAF test community to smartly address the use of Modeling and Simulation (M&S) to augment existing test capability. The Enhanced Air-to-Air and Air-to-Ground Linked Environment Simulation, or EAAGLES, is part of that directive. The ultimate goal is to use EAAGLES along with the existing capabilities in the test community, to reduce the impact of existing test program deficiencies in threat density and interoperability applications. Thus, EAAGLES becomes an important piece of the Virtual Test Range (VTR) infrastructure. As conceived, the VTR provides a common M&S infrastructure within the USAF acquisition and test communities, facilitating an easy and collaborative transition from acquisition activities to test.

This government managed and owned architecture/simulation could provide a truly transformational capability for Air Force M&S efforts. EAAGLES should be capable of supporting hundreds of manned and unmanned players in real time, running at up to 100Hz with full flight control systems and emission based avionics including electronic warfare systems. The design is underpinned with a proven real-time simulation architecture optimized to run on networked PC clusters. The ability to leverage low-cost yet high-end PCs in these networked clusters will make EAAGLES robust and scalable with the required fidelity to augment live test, adding hundreds of real-time digital and virtual players to live assets and to hardware-in-the-loop.

To date, architectural and trial demonstrations of the code, such as the air show configuration, have run aerodynamic and propulsion models, the core radar model, and high-resolution displays with out-the-window graphics, and have proven that real-time performance is achievable. Current code development is centered on designing specific electronic warfare systems functionality for classes of military aircraft types. Focus is also on development of the software infrastructure required for distributed simulation.

A collaborative test effort between SIMAF and the Major Shared Resource Center (MSRC) was conducted in October. The goals for this first Distributed Maturation Event (DME) were twofold. The first was to build and test a high-level architecture (HLA) interface to support future distributed simulations. The second goal was to test the robustness of the EAAGLES design and determine the player capacity at this early stage of development.

The test plan for the two-day DME 1, called for a gradual build-up of player capacity in the EAAGLES environment and in capacity over the network between the SIMAF and the MSRC. Measures of performance were collected to benchmark the initial HLA interface that underwent testing. Two piloted aircraft in SIMAF engaged numerous digital threats running in various combinations over one to 16 PC nodes in the MSRC. An AFRL/HEC AWACS simulation was also linked to EAAGLES during DME 1. The AWACS received and passed player locations within the scenario, testing data transfer over the Distributed Interactive Simulation (DIS) architecture in lieu of HLA.

The second and third DMEs are scheduled for later this fall with the Avionics Test and Integration Complex (ATIC) located at Edwards AFB. These events will evaluate other connectivity protocols and architectures and also integrate with EAAGLES, other specific models used by the ATIC to support developmental and operational test and evaluation.

Wright Cycles - A Heritage of and Commitment to Innovation

The ASC MSRC recently conducted a contest to name its journal. Orville Walters, Senior Database Analyst, Computer Sciences Corporation submitted the winning entry. According to Orville, "I wanted our journal to have a name that reflects the rich heritage of innovation in our area and our continued commitment to innovation. Based on that, I submitted the name *'Wright Cycles'*."

Wright Cycles brings to mind an image of Wilbur and Orville Wright. In 1892, the Wright Brothers started a bicycle manufacturing business, "The Wright Cycle Company", in Dayton, Ohio. Through innovation, dedication and hard work, they became the self-taught inventors of flight. They continued to perfect their invention over Huffman Prairie, nestled in what is now Wright-Patterson AFB, the location of the ASC MSRC.

As part of the High Performance Computing Modernization Program, the ASC MSRC hosts some of world's most powerful computers. These supercomputers boast some of the highest processing speeds available (measured in cycles). These computer cycles are put to use in many technology disciplines, which support the research and development critical to the DoD. The name *Wright Cycles* seems appropriate for the work done here at the ASC MSRC.

As Orville stated, "When you see *'Wright Cycles'* I hope you will think about our rich aviation heritage and the ASC MSRC's commitment to continued innovations." The selection committee hopes you will too.

Graphics Tools Available to Users

By Chuck Abruzzino and Rhonda Vickery

The Scientific Visualization Lab (SVL) at the ASC MSRC provides the latest computer graphics tools and personnel to enable our users to do everything from the exploration of large datasets to the creation of high-resolution, presentation quality graphics and animations. This state-of-the-practice lab also showcases the success stories of solving problems as they apply to the warfighter to the DoD community and the public.

Along with high performance computing, Scientific Visualization (SciVis) continues to evolve. A good roadmap for planning hardware and software is a blend of anticipating the needs of the user and matching the resulting requirements with emerging technologies.

This article presents an overview of the ASC MSRC SVL resources, as well as some potential directions for future upgrades.

SciVis Resources. The SVL houses the latest technology from Silicon Graphics, Inc. (SGI) for visualizing large datasets and multiprocessing. The SGI Onyx2 and Onyx3 systems support real-time processing of complex 3-D graphics, as well as 2-D imagery and high-resolution video. These systems employ the same shared-memory architecture as the SGI supercomputers to provide a fast access path from memory to disk, easing the burden of managing large datasets. These assets can be directed to drive a real-time visualization on the 1024x768 resolution Immersadesk or high-resolution desktop displays. On the Immersadesk, the view changes with the direction the master user is looking, which allows that user to get "inside" the data. Multiple participants can also view the immersive visualization from the master user's perspective. The Digital Video Multiplexer Option (DPLEX) on the Onyx3 can combine the power of the Infinite Reality graphics pipes into a single high-resolution display (utilizing all four consoles). Similarly, the Onyx2 system has two consoles that can be used together. These capabilities, along with 16 CPUs, 32 GB of memory, and over 500 GB of disk workspace, provide a high-performance visualization platform for those demanding large data applications. Additionally, a Dell PC running Linux is available for general and multimedia use. A complete description of all software and hardware is available at *https://xwww.asc.hpc.mil*.

The Video Preparation Facility (VPF). For video editing, an Avid Xpress non-linear video and audio editing system is available. A video preparation specialist uses this equipment to provide researchers with high quality videos in an appropriate format for conference or other group presentations.

Graphics and Multimedia Services. A graphics specialist is also available to assist the researcher in such areas as:

- Concept animation
- Computer modeling
- CD/DVD authoring and duplication
- Creation of high-resolution graphics for conference presentations

Other assets include two high quality printers (one of them color), as well as a 1600 dpi color scanner.

Where Do We Go From Here? Over the past few months a series of meetings have occurred with one goal in mind: to understand the visualization needs of our users and identify potential lab enhancements.

Results of the meetings generated a number of options:

1. Integrate the VPF with the lab via fiber optics for real-time data capture.
2. Increase the support staff with graphics support programmers that can assist DoD users in gaining better insight into their data. This may include enhancing visualizations for "pack and go" as well as web presentations.
3. Install one or more large high-resolution displays for training, 2-D or 3-D collaborative visualization, and immersive tours.
4. Provide PC multimedia workstations that have specialized tools for easy preparation of videos and presentations.
5. Provide and promote remote visualization technologies for cooperative work group sessions.

The above list represents some of the possibilities, but as of this writing, the roadmap is still very much in the information gathering stage. Brian Schafer is the POC for ideas and comments regarding the planning of future SciVis directions. Individuals wishing to provide input into this process are encouraged to email him at *Brian.Schafer@wpafb.af.mil*.

An important part of supporting a DoD facility is hosting tours and assisting with conference presentations. Showcasing the success stories of our users to the various civic, military, academic, and industry groups is a regular activity provided by SciVis personnel. To schedule a tour contact us via email at *asc.hp.outreach@wpafb.af.mil*.

Large Data File Transfers Over DREN

By Ralph McEldowney

How do you move 5 GBytes of data between two Defense Research and Engineering Network (DREN) sites in five minutes? That was the challenge facing the ASC MSRC in 1998 when the AF Weather Agency (AFWA) requested HPC hours to process weather data. Once AFWA had generated 5 GBytes of weather data at ASC, they wanted to transfer it back to Offutt Air Force Base for post processing.

The time required to transfer 5 GBytes over different circuits is shown in the table below. From this table, it is reasonable to conclude that 5 GBytes can be moved in five minutes between two OC-12 connected sites, as long as one-third of the bandwidth is available for the transfer, sustaining an average of 133 Megabits per second (Mbps).

Circuit	Bandwidth	Minimum Time (100% BW)	Minimum Time (33% BW)
T-1	1.5 Mbps	7.5 hours	22.5 hours
DS-3	45 Mbps	15 minutes	45 minutes
OC-3	155 Mbps	4 minutes	13 minutes
OC-12	622 Mbps	64 seconds	4 minutes
OC-48	2.5 Gbps	16 seconds	48 seconds

The problem was, in 1998 AFWA did not have a DREN connection, and the ASC MSRC only had a DREN OC-3 connection. Obviously, moving 5 GBytes in five minutes was not possible. However, with the recent DREN service upgrade provided by MCI, achieving this goal is now a possibility.

Since 1998, the ASC MSRC network staff has been on a mission to find a way to move 5 GBytes in five minutes. This is difficult to do, given the single stream Transmission Control Protocol (TCP) performance limitations that exist in applications such as File Transfer Protocol (FTP) and Remote Copy (RCP). An application search was conducted for a “parallel FTP” capability, one that would use multiple TCP streams to move a file, instead of a single TCP stream.

An application called Parallel Secure Copy (PSCP) was located at Sandia National Laboratory. PSCP is described by its developer as a “host to host file copy utility intended to enable greater transfer rates.” It uses Secure Shell (SSH) for encrypted user authentication, although the data streams are unencrypted. PSCP has a command line very similar to RCP and may be easily scripted. It can use between 1 and 64 parallel TCP streams, which is user selectable.

The ASC MSRC compiled the PSCP source code for SGI IRIX, Sun Solaris, Linux, IBM AIX, and HP-UX. Numerous tests were then conducted between hosts at various DREN OC-12 sites including each of the MSRCs. Files of various sizes including 5 GByte files were moved between hosts using 1, 4, 8, 16, 24, and 32 PSCP streams, as well as Secure Copy (SCP) and Kerberized FTP (KFTP).

In every test case, four or more PSCP streams resulted in better performance than a single stream, and significantly better performance than SCP or KFTP. For example, in a PSCP test between two IRIX machines located at different MSRCs, it took 1 hour and 10 minutes to transfer a 5 GByte file using SCP, and about 23 minutes using KFTP. The time differential is reasonable since SCP is encrypting the entire data stream while KFTP is not. A single PSCP stream between the same two machines took six minutes to move the 5 GByte file. Multiple PSCP streams of 4, 8, 16, and 32 all took about two and a half minutes to move the 5 GByte file, sustaining over 250 Mbps.

Similar results were obtained between other machines over DREN. Not all machines achieved such great results, but multiple streams were always better than one stream. Using PSCP it was possible to move 5 GBytes in under five minutes between hosts over DREN. In fact, the performance of PSCP exceeded expectations, and would be beneficial to all DoD researchers who need to move large files between sites.

The ASC MSRC is now negotiating with Sandia to obtain a DoD HPC-wide license to provide this capability to all DoD researchers. We expect this to be completed in the fall. Hopefully, the addition of PSCP will make it easier and quicker to move large data files between DoD HPC sites. For more information about PSCP or for the complete test results, please contact the author at *ralph.mceldowney@wpafb.af.mil*.

The Balanced Scorecard

By Steve Wourms

The various and sundry activities of my High Performance Computing Division give, essentially, innumerable opportunities for improvement. There are so many facets to this Division that I'll probably be learning about them until the time I depart. We need to measure how our 20-plus active teams and working groups are performing. But what do we measure? What's important?

We've settled on the Balanced Scorecard (BSC) as an approach to getting our activities better in line. The positive side of the BSC is that it is a *strategic management* approach. It begins with a solid and realistic strategic plan, expands to a number of achievable objectives, determines sets of metrics, which measure the progress on meeting the objectives of the strategic plan, and then continually develops initiatives to be undertaken to meet or exceed the thresholds of the metrics. BSC also stresses continual improvement with several feedback loops. It just so happens that these are all areas where our Division needs improvement!

On the downside, BSC does not come easily or quickly. It begins with the management team. Then with time, it pushes down through the layers of the organization until it becomes the basis for the every day activities of the troops on the front line. My personal concern is sustaining the implementation until BSC becomes a persistent part of our organization's culture. However, the commitment and dedication of the management team and the ASC MSRC staff provide the foundation to ensure our success.

I'm also eager to use the BSC as the framework within which to take a brand new look at the basic reason why we exist: the HPC customers. I want the customer perspective to permeate throughout the organization and become the guiding philosophy driving all our actions and decisions.

One step I have taken to increase emphasis on the customer perspective is to form a new branch within our Division. The Applications Management branch will focus on customer service. More importantly, the Applications Management branch will spearhead our Outreach effort ensuring that we stay in touch with our customers; not only potential customers but also our existing customers. I have named Maria Zimmer as the temporary chief of this new branch.

Steve Wilson continues as our chief of Infrastructure Management and Ralph McEldowney has accepted the position of temporary chief of the Advanced Technologies branch.

Stay tuned. There is much more to come. In the meantime, please let us know how we can better serve you.

Upcoming Conferences

November 15 - 21, 2003
Supercomputing Conference 2003 (SC03)
Phoenix Civic Plaza Convention Center
Phoenix, Arizona

December 1 - 4, 2003
Interservice/Industry Training, Simulation & Education Conference (I/ITSEC)
Orange County Convention Center
Orlando, Florida

December 8 - 11, 2003
The International Test and Evaluation Association (ITEA) Modeling & Simulation Workshop
Hilton Hotel
Las Cruces, New Mexico

December 8 - 12, 2003
Fall American Geophysical Union
Moscone Center West
San Francisco, California
DoD Challenge Project Session

January 5 - 8, 2004
American Institute of Aeronautics and Astronautics
Reno Hilton
Reno, Nevada
DoD Challenge Project Session

April 12 - 14, 2004
HPC User Forum
The Dearborn Inn
Dearborn, Michigan

April 12 - 16, 2004
SPIE Defense and Security Symposium (formerly AeroSense)
Gaylord Palms Resort and Convention Center
Orlando, Florida

April 18 - 22, 2004
High Performance Computing Symposium 2004 (HPC 2004) and
Advanced Simulation Technologies Conference 2004 (ASTC04)
Hyatt Regency Crystal City
Arlington, Virginia

June 7 - 11, 2004
DoD Users Group Conference
Williamsburg Marriott
Williamsburg, Virginia

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Wright Cycles
ASC/HP Bldg 676
2435 Fifth Street
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